

## "Corruption, Gender Inequality and Logistics Performance"

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**Purpose:** To develop and test theory-driven hypotheses on the influence of corruption and gender inequality on logistics performance.

**Design/methodology:** This paper develops hypotheses based on a review of the literature and theory linking corruption, gender inequality and logistics performance. Testing the hypotheses draws on the following secondary data sources: the World Bank Logistics Performance Index (LPI), Transparency International's Corruption Perceptions Index (CPI) and the United Nations Development Programme (UNDP) Gender Inequality Index (GII). Regression analysis is used to test the hypotheses.

**Findings:** A significant direct effect is evident between corruption perceptions and perceived logistics performance. Corruption is detrimental to logistics. Further, there is evidence of an indirect effect, via gender inequality. Gender inequality is also linked directly to lower logistics performance. GDP/capita enters the analysis as a control variable.

**Research limitations/implications:** While the analysis uses secondary data, sources are credible and their methods – while not perfect – are logical and appear to be reasonable. It is possible that excluded variables could further explain the relationships under study. This implies future research opportunities, perhaps involving case studies of specific nations.

**Practical implications:** The results should inspire businesses, NGOs and governments to invest in, aid, advocate for and legislate toward greater gender equality – and against corruption. Logistics educators have an important role in disseminating this message.

**Social implications:** Gender inequality and corruption are current, global social issues. Moving forward toward equality and away from corruption are the right moves. Such moves appear to also yield better logistics.

**Originality/value:** This paper is among the first linking corruption and gender inequality to logistics performance. It shows how social issues impact logistics performance at a national level.

**Keywords:** corruption; gender inequality; logistics performance; regression analysis

**Article Classification:** Research paper

## Introduction

Putting matters of morality aside for the moment; rampant corruption and gender inequality are hard on the world's wallet. According to the World Bank Group (2017), "Businesses and individuals pay an estimated \$1.5 trillion in bribes each year. This is about 2% of global GDP—and 10 times the value of overseas development assistance" (ODA). Based on World Economic Forum research, Thomson (2017) suggests \$2 trillion a year is wasted on corruption. Wodon and de la Brière (2018) estimate that the cost of gender inequality in earnings alone runs far into the trillions. Amidst this corruption and inequality, global logistics spending is expected to reach \$10.6 trillion by 2020 (Henderson 2018).

On January 1, 2016, the United Nations Sustainable Development Goals (SDGs) were officially launched. The 17 SDGs, and their 169 targets, are an ambitious plan to make the world a better place via economic growth, social inclusion and environmental protection (UN 2018a). Goal 16, *Promote just, peaceful and inclusive societies*, includes a focus on corruption. Among the targets for this SDG is to: "Substantially reduce corruption and bribery in all their forms." Goal 5, *Achieve gender equality and empower all women and girls*, addresses gender inequality. One of its targets is to: "End all forms of discrimination against all women and girls everywhere." The IASC (2017) asserts that: "Cultural practices regarding gender provide some of the most fundamental sources of inequality and exclusion around the world."

This study begins with the observation that logistics performance varies dramatically across nations. Thus, the quest is to identify possible root causes of this variation. National income is a candidate predictor – "rich" nations should have better logistics (Arvis et al. 2016). Given that around half of potential logistics personnel are women, gender inequality within nations arises as another possible predictor of national logistics performance. Corruption, which also appears to vary widely across nations, emerges as yet another predictor of logistics performance, based on two recently published studies. Does corruption facilitate (Koh et al. 2018) or hinder (Wong and Tang 2018) logistics performance?

Despite the profound potential implications of lingering gender inequality and ongoing corruption in the world, there is surprisingly little research linking these constructs (especially

gender inequality) to logistics performance. Wong and Tang (2018, p. 432) note the “lack of studies on major factors associated with logistic performance especially in the global context.” There appear to be only a few such published studies, e.g. d’Aleo (2015); Guner and Coskun (2012); Koh et al. (2018); and Uca, Ince and Sumen (2016).

Mateu (2017) suggests that gender diversity in the workplace enhances collaboration, tolerance, productivity and corporate social responsibility. Unfortunately, while women make up 46.8 percent of the American workforce, they account for only 22.6 percent of the nation’s transportation and logistics workers. American women in logistics are also paid less than their male counterparts – \$81,385 vs. \$119,236, on average (Burnson 2017). Similar results have been reported in Canada (Larson and Morris 2014). According to the South Australian Freight Council, benefits of gender equality in logistics include increased employee satisfaction and innovation, enhanced customer service, and improved financial performance (SAFC 2015).

In the global business environment, logistics managers not only face gender inequality, they must also confront corruption (Burnson 2015). Transparency International (TI) defines corruption as “the abuse of entrusted power for private gain.” TI differentiates between grand, petty and political corruption. *Grand* corruption occurs at high levels of government, creating fabulous personal wealth for “leaders,” by sacrificing the well-being of the people. *Petty* corruption involves abuse of power by lower-level officials, compromising citizens’ access to basic public services through bribery, extortion, etc. *Political* corruption involves manipulation of policies, institutions and procedures by political decision makers in allocating resources to sustain their own personal power, status and wealth (<https://www.transparency.org/what-is-corruption#define>).

Depending on where in the world firms attempt to conduct business, they may lose out to corrupt competitors or be forced to deal with corrupt government officials. Corruption adds another element of risk to expansion plans and capital investments. Burnson (2015) advocates embedding anti-corruption targets and compliance into corporate culture.

Within and across nations, organizations (businesses, government agencies and non-governmental organizations) are the primary entities performing logistics activities. If gender

inequality and corruption are detrimental to organizational logistics, these perils also probably have a negative impact on national logistics performance. This paper addresses the following research question: How do corruption and gender inequality impact logistics performance, at a societal/national level? Thus, the study extends “macro-logistics” (Havenga 2018) beyond economics and into the socio-economic realm. Its primary, unique contribution involves the development and empirical testing of theory-driven hypotheses on the links among corruption, gender inequality and logistics performance.

After this first, introduction section, the second section of the paper reviews the relevant literature. This part includes development of five hypotheses. The third section then describes statistical methods for hypothesis testing, along with measurement of the constructs. Next, section four provides results of hypothesis testing. The fifth (final) section offers conclusions, including policy implications, limitations and ideas for future research.

### **Literature / hypothesis**

The literature search focuses initially on the ABI/INFORM Global database, which contains full text of thousands of scholarly and trade journals. The search strategy is to identify articles covering pairwise combinations of the primary constructs: corruption, gender inequality and logistics performance. Focusing on these pairwise combinations supports development of hypotheses among the constructs.

A recent search of the database for *peer reviewed* articles with relevant search terms in their abstracts yields the following results: 5,854 articles on “corruption,” 608 on “gender inequality” and 189 articles on “logistics performance.” While the search for publications on “logistics performance” did not further specify an interest in macro- or micro-oriented articles, an overwhelming majority of the research appears to have a micro (i.e. organizational) focus.

Upon using combinations of the search terms, research output declines dramatically – to eight articles on corruption and gender inequality; and two articles on corruption and logistics performance (Koh et al. 2018; Wong and Tang 2018). Both articles adopt the TI definition of corruption and the CPI as an indicator of corruption. No articles were found combining gender inequality and logistics performance. Additional relevant articles and reports were discovered

while studying the original articles identified using search term combinations (e.g. Arvis et al. 2016; Glushkova et al. 2017; Seabra, Flores and Gomes 2016).

### *Corruption and logistics performance*

Koh et al. (2018) claim there had been no statistical research on the link between corruption and logistics performance. These researchers adopt the resource-based view (RBV): corruption control and good governance are considered resource factors, which serve to improve logistics performance. They wonder whether corruption greases the wheels of economic development – or grinds them to a halt. Is corruption necessary to make things happen in some countries? Or, is corruption a scourge that results in inefficient logistics and raises the cost of trading?

The RBV focuses on the role of resources in determining organizational (or in this case national) performance. A nation is also an organization. Following Arvis et al. (2018), national logistics performance includes matters of public policy and regulation (e.g. customs procedures and infrastructure) and delivery outcomes (e.g. timeliness). While a novel application of the RBV, it is not without precedent. Truyens et al. (2014) adopt the RBV in studying how national resources and capabilities affect the competitive position of nations' elite athletics programs. In another national level study, Degraevl (2015) investigates the connection between the RBV and national culture. In addition, two recent studies on logistics performance also adapt the RBV to the national level of analysis (Koh et al 2018; Wong and Tang 2018).

Resources include tangible assets, such as land and capital, as well as intangible assets. Among a nation's intangible assets are its reputation, laws and regulations, labor skills and availability, along with treatment of its citizens and workers (Jurevicius 2013). Two important characteristics of national resources are: *heterogeneity* of available resources from one nation to another; and *immobility* or difficulty of transferring resources between nations in the short-run.

Koh et al. (2018) examine empirical linkages between the Logistics Performance Index (LPI), the Corruption Perceptions Index (CPI), and government effectiveness (GE) from the World Bank's governance indicators from 2007 to 2014 for 26 Asian countries. Logistics performance is viewed as a trade facilitator, an aspect of national competitiveness. Arvis et al. (2018) note

the role of logistics in facilitating international trade. Effective logistics service reduces the cost of trade. Hausman, Lee and Subramanian (2013) review the literature on logistics performance and international trade. Better logistics performance yields higher customer service levels and lower landed costs. Their empirical study reveals a significant positive link between logistics performance and volume of bilateral trade between nations.

Based on regression analysis, Koh et al. (2018) conclude that CPI significantly affects LPI; and governance (GE) has a moderating effect on the CPI/LPI relationship. Their study supports the “greases the wheels” hypothesis – i.e. more corruption and weaker governance yield higher logistics performance, among Asian nations.

According to Sudibyo and Jianfu (2015), institutional theory suggests corruption is caused by poor understanding and enforcement of regulations, lack of commitment to eradicate it, lack of transparency and administrative complexity. Guided by institutional theory and the RBV, Wong and Tang (2018) compile a dataset including LPI and CPI measures for 93 countries over four years. They find lower corruption and more political stability related to higher national logistics performance. By complementing the RBV with the concept of institutional quality, Wong and Tang (2018) view corruption as an obstacle to economic and social progress. They view the CPI as an indicator of institutional quality. Public sector institutions, as policy makers, regulators and law enforcers, influence the level of corruption within a nation.

Seabra et al. (2016) use the CPI, the LPI and the World Bank’s (ease of) Doing Business (DB) Index to compare container port traffic across the following 10 emerging countries: Argentina, Brazil, Chile, Colombia, Peru, China, India, Malaysia, Russia and South Africa. They discover a direct relationship between the LPI and container trade growth, and suggest that low logistics performance and bribery (corruption) increase overall port operations costs. Guner and Coskun (2012) analyze a set of social and economic correlates of LPI across 26 OECD countries. They report a weak correlation between LPI and GDP, and stronger correlations between LPI and political risk (including control of corruption), the Economist Intelligence Unit’s Democracy Index and the United Nations Human Development Index (HDI). In a broader, more global analysis, Uca et al. (2016) report significant direct effects of CPI on LPI and of LPI on national

foreign trade volume. In addition, their results confirm a mediator effect of LPI on the link between CPI and foreign trade volume.

Koh et al. (2018) suggest that corruption could “grease the wheels” and enhance logistics performance. However, the current study views corruption as detrimental. It focuses attention on matters other than logistics performance, resulting in infrastructure investment and service provision based on criteria other than improving customer service and reducing total logistics costs. National laws and regulations against corruption are intangible resources which directly influence logistics performance. Inspired by institutional theory and the RBV (Wong and Tang 2018), the first hypothesis is –

H1: Countries with higher levels of corruption have lower logistics performance.

#### *Corruption and gender inequality*

Noting that women are disproportionately affected by corruption, Berazategui (2019) argues that “anti-corruption measures are central to reducing the gender gap.” Similarly, Swamy et al. (2001) suggest there is more discrimination against women in countries that are more corrupt. To explain this connection, Ionescu (2011) states: “corruption supports, stabilizes and deepens inequality within societies” (p. 404). In another study, Branisa and Ziegler (2010) hypothesize that societal attitudes regarding gender inequality influence corruption. Using Transparency International’s CPI – and gender inequality measures from the OECD Gender, Institutions and Development database – they found a statistically significant relationship ( $p < .01$ ) between social institutions favoring gender inequality and corruption. The logarithm of GDP per capita was also a significant predictor of corruption.

In related research, Rambanapasi (2012) hypothesizes that economic development is diminished by corruption (including bribery and the misappropriation of funds) and gender inequality. He explains: “... gender inequality may result in the most qualified personnel not occupying positions because of sexual discrimination” (p. 81). In an empirical test, GDP per capita serves as the dependent variable, while the independent variables include CPI, the United Nations Gender Inequality Index (GII), political stability and cultural individuality. In his

best fit model, gender inequality and corruption explain 74 percent of the variance in GDP per capita (Rambanapasi 2012).

Marsh (2014) suggests that, “Poverty, income inequality, and the subjection of women undermine capabilities and deprive people of their effective freedoms to engage in worthwhile activities” (p. 1002). Using various statistical indices and secondary data, he finds that GDP per capita and ethnolinguistic fractionalization (ELF) are significant predictors of gender inequality. A second model reveals that corruption is a significant predictor of income inequality. Chêne and Fagan (2014) argue that corruption “serves to reinforce social, cultural, political and institutional discrimination” which many women face on a daily basis. Recently, Yoon (2018) reports a significant link between the CPI and gender inequality, while the #MeToo movement calls for exploration of the “interplay between corruption and gender” (Bettinger-Lopez and Hughes 2018).

Kelly (2018) describes differences between economies of exploitation and affection. In terms of relationships, an economy of exploitation is based on separateness – of humans and nature, including other animals; of men and women. This separateness facilitates corruption and gender inequality. While togetherness inspires equality and respect, separateness opens the door for gender inequality and corruption. Bahr (2015) links the concept of togetherness or inseparability to Indigenous cultural perspectives, with a deep connection to land and nature. This is an economy of affection. Driven by exploitation/affection, corruption and inequality in a nation go hand-in-hand, with more corrupt countries likely to also suffer from greater gender inequality.

The theory of economic affection vs. exploitation also aligns with the “moral economy” concept. Carrier (2018) argues that an economy (i.e. a nation) can be viewed as more or less moral; it is a matter of degree. While Arnold (2001) asserts that moral economy offers an anti-thesis to “rational choice” in the material sense, Götz (2015) suggests it can clarify alternative ways to maximize utility. A moral economy focuses on fairness, justice and mutuality, rather than “freedom” from these values.



Guided by the literature on corruption and gender inequality, along with moral economy/ economy of exploitation theory, the second hypothesis can be stated as follows –

H2: Countries with higher levels of corruption have higher levels of gender inequality.

*Gender inequality and logistics performance*

While the database search identified no articles combining these two constructs, there is a slight trace of literature on gender issues in logistics. Kovács and Tatham (2009) focus on gender issues and logistics performance in humanitarian organizations. They observe that female beneficiaries or recipients of aid have unique exposure to peril, needs and access to relief. These authors also note an anomaly: while the majority of relief workers are female, there are relatively few female humanitarian logisticians. In a related piece, Tatham and Kovács (2010), attribute gender differentiation in disaster vulnerabilities to *sex segregation* of certain activities within a geographical area, i.e. to “the cultural specificity of gender socialisation.” The above quoted phrase is a rather diplomatic reference to gender discrimination and inequality ...

According to the RBV, labor skills and availability, along with the treatment of workers and citizens, are determinants of performance. Gender inequality implies discrimination against half of the workforce and prospective end-customers or beneficiaries. Mistreatment of 50 percent of such an important resource (human capital) is likely to harm overall performance. Further, it is hardly the ticket to outstanding logistics performance. Control of corruption and movement toward gender equality are viewed as institutional quality and resource factors; factors which can facilitate logistics performance improvement. As noted above, the theory of separateness and economies of exploitation vs. affection link corruption to inequality and imply an indirect link between corruption and logistics performance, via gender inequality. This is in addition to the direct corruption/logistics performance link. These theories inspire two more hypotheses, as shown below –

H3: Countries with higher levels of gender inequality have lower logistics performance.

H4: Gender inequality is a mediator of the corruption/logistics performance relationship.

### *Control variable – GDP/capita*

Most of the logistics performance literature looks at performance at the organizational level (e.g. Chow et al. 1994; Fugate et al. 2010; Aharonovitz et al. 2018). However, several articles focus on logistics at the national level. Using the LPI, Hausman et al. (2013) investigate the impact of logistics performance on global bilateral trade. d'Aleo (2015) formulates a linear regression model with LPI as a mediator on the link between the World Economic Forum's Global Competitiveness Index (GCI) and Gross Domestic Product (GDP) from 2007 to 2014 among the EU-28 nations in the European Union. As expected, the LPI is shown to be a significant mediator of the relationship. In an application of path analysis to secondary data from 116 countries, Lee and van Wyk (2015) report positive, direct effects of political freedom and global competitiveness on the LPI. Furthermore, economic and political risks, as well as economic freedom, have indirect effects, via political freedom and/or global competitiveness. They view corruption as an element of political risk.

Vaillancourt and Haavisto (2016) analyze national logistics performance (using the LPI) as a predictor of number of people affected by disasters in 117 countries from 2007 to 2012. With a series of multiple regression models, they identify the LPI, the HDI, and population as significant predictors of number of people affected by disasters. As a nation's logistics performance slips, more people are affected by natural disasters.

Arvis et al. (2016; 2018) present a positive regression relationship between GDP/capita and LPI. It seems economically successful nations invest a portion of their income toward improving logistics performance. (Reciprocally, strong logistics performance likely enables higher income levels.) However, Arvis et al. (2018, p. 15) suggest that national "income alone cannot explain why (logistics) performance varies widely among countries." In the current study, GDP/capita is included in the analysis as a control variable. Guided by the literature on national income and logistics performance, the fifth and final hypothesis is –

H5: Countries with higher GDP/capita have higher logistics performance.

## Methodology

Secondary data can be useful for logistics research across a variety of topics, e.g. sustainability and logistics performance. Ellram and Tate (2016, p. 251) note that established “secondary data sets are often already validated” and have high internal validity. They advise researchers to use established sources and to carefully consider construct validity. According to Houston (2004), construct validity of secondary data starts with *content validity* (whether the indicators appropriately align with the constructs of interest); and ends with *nomological validity* (whether the indicators fit within a theoretically-derived network of constructs).

The variables needed to test the hypotheses – logistics performance, corruption and gender inequality – are drawn from secondary data sources, as described below. All three indices (LPI, CPI and GII) are computed by well-established sources, for the main purpose of measuring the respective constructs to enable comparisons across countries. The indices have also been used numerous times in prior research. There is a strong sense of content validity, i.e. that these indicators match the constructs of interest in the current study. These three indices are current, calculated using enduring methods, and quantitative – enabling statistical testing of their inter-relationships. Ultimately, testing the hypotheses is needed to establish nomological validity of this secondary data set.

### *Logistics Performance Index (LPI)*

The LPI is based on a survey of freight forwarders and express carriers conducted biennially by the World Bank. It measures perceived logistics performance at the national level, enabling comparisons across many countries in the world. Thus, the LPI can aid in the identification of challenges and opportunities for improving national logistics performance (Arvis et al. 2018).

While the LPI appears to be the only measure of national logistics performance covering a wide range of countries, it is not without limitations. Shcherbanin (2017) implies Russia’s low LPI rating is due to lack of a “strong scientific validity” of the index. In addition, the LPI could be criticized for its reliance on perceptions of logistics professionals rather than objective metrics, such as percent of orders delivered on-time. On the other hand, it could be argued that these

perceptions reflect the opinions of experts as qualified informants – and are valid measures of the logistics performance of nations.

There are six primary elements in the LPI, all rated from 1 to 5 (very low to very high, except as noted below). The six elements are:

- (1) Efficiency of customs and border management clearance.
- (2) Quality of trade and transport infrastructure.
- (3) Ease of arranging competitively priced international shipments; very difficult (1) to very easy (5).
- (4) Competence and quality of logistics services.
- (5) Ability to track and trace consignments.
- (6) Frequency with which shipments reach consignees within scheduled or expected delivery times; hardly ever (1) to nearly always (5).

As noted above, LPI ratings data come from an online survey of international logistics practitioners. Each practitioner/respondent rates the logistics performance of eight countries on the six elements. Countries are assigned to survey respondents in quasi-random fashion, accounting for income level (low, middle or high) of their home country, along with whether the respondent is from a coastal or a land-locked country (Arvis et al. 2018).

Principal components analysis (PCA) of the normalized ratings is used to generate weights for the six LPI items. For the 2018 data, these weights range from .40 to .42. Thus, the LPI is essentially the average rating across the six core elements of logistics performance (Arvis et al. 2018). PCA of the 2018 LPI raw data reveals that a single factor explains 92.3 percent of the variance in these six items, with factor loadings ranging from .932 to .980.

Additional (non-LPI) questions on the global survey cover the *transparency of customs clearance* and *solicitation of informal payments*, rated from hardly ever or rarely to often or nearly always. The latest LPI report (Arvis et al. 2018) contains no mentions of “gender” and only one mention of “corruption;” noting greater improvement on “incidence of corruption” among second and third quintile LPI countries (p. 15). The report also observes a significant correlation between LPI and log (GDP/capita) among the included countries. Glushkova et al.

(2017) confirm a positive link between LPI and national income. For 2018, the LPI is calculated for 160 countries.

### *Corruption Perceptions Index (CPI)*

In economic terms, corruption typically depletes the wealth of a nation. Corrupt leaders allocate scarce public resources to programs and projects that increase their personal wealth rather than benefit their constituents, the people. For instance, large-scale projects that benefit the few (e.g. oil pipelines) are selected over more urgent infrastructure projects that benefit many people (e.g. road improvements). Corruption also impedes fair, open market practices, limits competition – and makes investors nervous (<https://www.transparency.org/>). In addition, TI asserts that: “Corruption and inequality feed off each other, creating a vicious circle between corruption, unequal distribution of power in society, and unequal distribution of wealth” (CPI 2016).

To construct the CPI, TI combines data from 13 credible sources of information on public sector corruption. These sources include the Economist Intelligence Unit, the World Bank and the World Economic Forum (WEF). Each source is evaluated in terms of: reputation, reliability of methods, conceptual alignment (of the data), granularity (minimum of four-point scales), and cross-country comparability. At least three data sources must assess any given country for it to be included in the Index (CPI 2018).

All source data sets are reverse-coded if necessary and then standardized to a scale from 0 (high corruption) to 100 (low corruption). The final CPI score for a country is the mean of all its standardized scores. Thus, for each included country, CPI varies from zero (highly corrupt) to 100 (corruption-free). For 2017 and 2018, CPI is computed for 180 countries and territories. In 2017, the CPI methodology was audited by the European Commission Joint Research Centre.

In an earlier study, Wilhelm (2002) found significant correlations among three measures of corruption, including the CPI. Its significant correlation with GDP per capita provided additional evidence of the CPI’s validity. Nonetheless, the CPI has been criticized for using measures of perceived corruption rather than actual corruption (Louis 2007; Steinbock 2018). Reliance of

the CPI on opinions of country experts and international business executives (Heywood 2016) and its focus on public sector corruption (Steinbock 2018) has also been criticized.

However, it can be argued that gathering experts' perceptions is a reliable (consistent) and valid method for assessing relative levels of corruption among nations (Anon. 2013). Moreover, national level corruption is (arguably) more embodied in public sector policies and practices, as opposed to the actions of a private sector dominated by multi-national corporations. Despite its limitations, Heywood (2016) observes that the CPI is the first systematic attempt to measure perceived corruption across many countries and it is "the established go-to source" for data on levels of corruption around the world.

### *Gender Inequality Index (GII)*

According to the United Nations Development Programme (UNDP), gender inequality is a major barrier to human development. Women and girls face ongoing discrimination in the areas of health care, education, representation in politics and participation in the workforce. The result is compromised development of capabilities, and reduced freedom of choice. Constructed by the UNDP, the GII estimates gender inequality on three critical aspects of human development: health (maternal mortality ratio), empowerment (educational achievement and participation in national politics) and labour force participation rate. Higher GII scores mean greater gender inequality. The most recent index (2017) is computed for 160 countries, revealing gender gaps and possible public policy options for overcoming obstacles faced by women (UNDP 2018).

Data used to compute the GII come from the following sources: the International Labour Organization (ILO), Inter-Parliamentary Union (IPU), United Nations Department of Economic and Social Affairs (UNDESA), United Nations Educational, Scientific and Cultural Organization (UNESCO) and the UN Maternal Mortality Estimation Group. Computing the Index involves aggregating data within gender groups using geometric means, and then aggregating across the two groups with a harmonic mean. This accounts for overlapping inequalities across the three dimensions. The means of each indicator are used to calculate the GII as a deviation from the standard of equality. For any given nation, the Index can range from 0 ("gender equality") to 1 (maximum inequality).

Permanyer (2013) argues that the GII's functional form is "excessively and unnecessarily confusing," and advocates incorporating the GII variables in a clearer functional form. In terms of validity, the GII is significantly correlated with the World Economic Forum's Global Gender Gap Index ( $r = .527$ ;  $p\text{-value} = .000$ ), which also includes indicators of labour force participation, educational attainment, health and political empowerment (WEF 2018). An advantage of the GII over the WEF index is coverage of more countries – 160 countries versus 144 by the Global Gender Gap.

{Figure 1 here}

Since the dependent variable (LPI) is continuous, hypotheses are tested using regression analysis. The PROCESS macro bootstrapping technique (Hayes 2017; 2018) enables statistical testing for mediation. PROCESS can be downloaded and added to the SPSS regression module (<http://processmacro.org>). Testing H1-H4 involves analysis of the paths shown in Figure 1. The analysis proceeds as follows: (1) test for significance of path c; (2) test for significance of path a; (3) test paths b and c' using multiple regression analysis; and (4) assess the mediation effect of gender inequality. A multiple regression with GDP/capita as a control variable is also run to address possible concerns over omitted variable bias (OVB). Of course, OVB is unavoidable, since it is impossible to include all relevant variables in a regression model (Clarke 2005).

## Results

The analysis starts by testing for a link between CPI and LPI (the direct effect, i.e. path c in Figure 1). As shown in Table 1, path c, the direct relationship between corruption (CPI) and logistics performance (LPI) is positive and significant ( $t = 15.798$ ;  $p\text{-value} < .001$ ). Recall that higher CPI means less corruption and higher LPI means better logistics performance. Thus, the data support H1. Path a, the link between corruption and gender inequality (GII) is negative and significant ( $t = -13.297$ ;  $p\text{-value} < .001$ ). Note: higher GII implies greater gender inequality. Therefore, H2 is also supported by the data.

Next, a third regression model is run, with both CPI and GII as predictors of LPI. Path b, the link between gender inequality (as the mediator) and logistics performance is negative and significant ( $t = -5.398$ ;  $p\text{-value} < .001$ ). Thus, the data support H3. Finally, path c', the relation

between CPI and LPI, controlling for GII, is positive and significant ( $t = 7.477$ ;  $p\text{-value} < .001$ ). Since the beta coefficient for path  $c'$  (.0153) is smaller than that for path  $c$  (.0236), there is evidence of partial mediation.

The Beta coefficients in Table 1 enable several interesting, albeit cautious interpretations. Beta for path  $b$  (-1.0896) implies: if GII increases by 1.0 – and CPI remains constant – LPI would decline by  $\sim 1.09$ . However, the possible range of GII is only 0 to 1.0, and the GII data range from .039 (Switzerland) to .835 (Yemen). Still, gains in gender equality are clearly related to higher logistics performance. Beta for path  $c'$  (.0153) implies that CPI would have to increase by about 66 ( $66 \times .0153 \approx 1.0$ ) – with GII remaining constant – for LPI to rise by 1.0. Note: the CPI data range from 15 (Afghanistan) to 89 (New Zealand).

{Table 1 here}

Beta coefficients are also used to get an estimate of the magnitude of mediation. The ratio of indirect effect/total effect provides an estimate of the mediator effect size or the amount of mediation (Shrout and Bolger 2002). The ratio is calculated as  $B_a \times B_b / B_c$ , using Beta coefficients for paths  $a$ ,  $b$  and  $c$ . In the current case, percent mediation is  $-.0076 \times -1.0896 / .0236 = .3509$ . Thus, the mediator accounts for about 35 percent of the total effect. Statistical significance of this indirect effect can be tested using the conservative Sobel (1982) test, by calculating a Z-score, as follows:  $Z = B_a \times B_b / (B_b^2 \times S_a^2 + B_a^2 \times S_b^2)^{1/2}$

This formula uses the Beta coefficients as above and standard errors ( $S$ ) for paths  $a$  and  $b$ . If  $Z > 1.96$ , the indirect effect is significant at  $\alpha = .05$ . In the current case,  $Z = 4.965$ . This result supports H4. The bootstrapped confidence interval of the indirect effect offers another statistical test for mediation (Mackinnon 2015). Analysis with the PROCESS macro (Hayes 2018) yields the following 95 percent bootstrapped confidence interval of the indirect effect: .0049, .0119. Since zero (0) is not in the interval, the effect is significant at  $\alpha \leq .05$ . This supports H4, i.e. that gender inequality is a (partial) mediator of the relationship between corruption and logistics performance.



In summary, calculations using the Beta coefficients and the PROCESS macro bootstrapping technique both confirm gender inequality as a mediator of the relationship between corruption and logistics performance.

#### *Regression analysis with the control variable*

Using Cook's distance metric and the centered leverage values, several outliers are identified in the dataset. The Cook (1977) distance metric identifies influential observations (i.e. outliers) in linear regression, since such data points might distort the outcome and accuracy. It measures the impact of deleting a particular observation.

Bhutan is a rather unusual case due to relatively poor logistics performance despite low corruption. It is interesting to note that Bhutan is landlocked, by India to the south and Tibet (China) to the north. Libya also suffers from poor logistics performance, but rates rather well in terms of (low) gender inequality. In addition, Luxembourg is similar to its neighbors on LPI, CPI and GII, but the country enjoys an extraordinarily large GDP/capita. However, since none of the outliers are deemed "extreme" (i.e. standardized residual outside plus or minus 3.0), the full dataset is analyzed.

Data on all four variables is available for 139 countries. Table 2 reveals the regression results, with GDP/capita as a control variable. The three predictor variables (CPI, GII and GDP/capita) explain 71% of the variance in LPI ( $R\text{-square} = .713$ ) and overall fit between the data and model is significant ( $F = 111.727$ ;  $p\text{-value} = .000$ ).

The results indicate there are no issues of autocorrelation among the regression residuals, since the Durbin-Watson statistic (2.036) is near 2.0. The histogram provides evidence that the standardized residuals are normally distributed, as they are centered on zero and range almost exclusively between (plus/minus) two standard deviations. Furthermore, the normal P-P plot of standardized residuals supports linearity. Finally, the scatterplot of standardized residuals vs. predicted values is centered on zero and ranges mostly between (plus/minus) two, with respect to both X and Y axes, providing evidence of homoscedasticity.

The collinearity statistics (VIFs between 2.4 and 4.1) in Table 2 suggest multicollinearity is not a serious concern among the independent variables. According to Akinwande et al. (2015),

VIFs between 5 and 10 indicate high correlation that may be a problem, and VIFs > 10 imply the regression coefficients are poorly estimated due to multicollinearity. Of course, correlation is expected among the independent variables, given the mediation model (refer to Figure 1).

{Table 2 here}

Results in Table 2 confirm support for H1, the link between corruption (CPI) and logistics performance (LPI). The t-statistic (3.779; p-value = .000) is significant at the .01 level of alpha. As expected, H3 – the gender inequality/logistics link – also finds support (t = -4.849; p-value = .000, for a one-tail test). Finally, the control variable, GDP/capita, is significantly and positively related to logistics performance (t = 2.524; p-value = .007), as expected.

## **Conclusions**

According to Arvis et al. (2016, p. 30): “Policy makers are increasingly looking for data so they can base decisions on facts.” Here are several facts following from the above data analysis. First, perceptions of corruption are clearly detrimental to perceived logistics performance. The more corrupt the country, the lower its performance. This result is contrary to prior “greases the wheels” findings (Koh et al. 2018) but confirms previous “grinds to a halt” findings (Wong and Tang 2018), in alignment with the RBV and the concept of institutional quality. Second, corruption is linked to gender inequality, as suggested by economies of exploitation theory and the concept of inseparability. Further, the inter-related nature of the SDGs (UN 2018b) is also confirmed by these results, with particular reference to Goal 5 (gender equality) and Goal 16 (peace, justice and strong institutions).

Third, gender inequality is detrimental to logistics performance, as predicted by RBV logic – and it mediates the link between corruption and logistics performance, i.e. there is an indirect effect between corruption and logistics performance, through gender inequality. This is the primary contribution of the study: development of theory-driven hypotheses and empirical testing of inter-relationships among perceived logistics performance, perceptions of corruption and gender inequality.

### *Policy implications*

It appears that gender inequality goes hand-in-hand with corruption, and it has a detrimental direct effect on logistics performance. It also mediates the negative influence of corruption on logistics performance. While the unit of empirical analysis in this study is the nation, gender inequality within nations is largely embodied in the policies and actions of organizations. Thus, organizations are advised to invest in gender equality. Businesses and government agencies should treat female and male employees as equals, in terms of pay and working conditions – and encourage others to do the same.

Such policy recommendations are as ambitious as the SDGs. Recall Goal 5: “Achieve gender equality and empower all women and girls.” A recent UN report on the SDGs observes:

“While some forms of discrimination against women and girls are diminishing, gender inequality continues to hold women back and deprives them of basic rights and opportunities. Empowering women requires addressing structural issues such as unfair social norms and attitudes as well as developing progressive legal frameworks that promote equality between women and men” (UN 2018b, p. 6).

Governments should legislate in favor of greater gender equality. Treat female and male citizens as equals, and make it illegal for other organizations to do otherwise. While legislation alone cannot assure gender equality, it seems a good place to start. Supply chain and logistics educators also have a role to play, in disseminating the message that gender inequality is bad policy; it is morally repugnant, detrimental to logistics excellence – and bad for business.

As part of providing development aid to improve logistics infrastructure, humanitarian aid donors and non-governmental organizations (NGOs) should promote gender equality. Perhaps aid should even come with gender equality “strings” attached. Consider the idea that a lack of development and poor logistics performance are only symptoms – while gender inequality and corruption are among the afflictions in more urgent need of treatment.

Of course, businesses, NGOs and governments are also advised to act, advocate and legislate in favor of anti-corruption practices. Perhaps inspired by where they often work, humanitarian relief NGOs appear to be the leaders in dealing with corruption and gender inequality. There are a variety of logistics policy variables to consider, e.g. customs procedures,

awarding of large infrastructure contracts, standards of services quality, etc. For instance, Chêne (2009) describes actions to address gender inequality and corruption in humanitarian response, such as: including women in aid program design and implementation, providing transparency and open access to information, introducing complaint mechanisms and raising aid workers' ethical standards.

### *Limitations*

One limitation of the current study is its use of secondary data sources, compiled for purposes other than testing the hypotheses developed above. Several specific limitations of the indices used in this study were discussed in the methodology section above. However, the data comes from credible, independent sources, and the dataset appears to provide reasonable measures of the relevant constructs.

Another limitation is the possibility that excluded variables, as predictors or mediators, may offer greater explanation of logistics performance variation across nations. GDP/capita is included as a control variable in the current study, but other relevant independent variables may still be omitted. For instance, variables describing the geography of nations or cultural characteristics may be related to logistics performance. Political stability and proneness to natural disasters are further possible predictors of performance. Naturally, such additional variables imply future research opportunities.

### *Future research*

Drawing on a 139-nation dataset, this study provides statistical evidence of linkages among corruption, gender inequality and logistics performance. An important opportunity for further research would be to study specific countries as single cases. Interesting, qualitative research questions could include: How are elements of national or regional culture related to corruption and gender inequality in a country? Why is corruption and/or gender inequality tolerated in the country? How do corruption and inequality impact logistics performance in the country? Qualitative methods might also be used to compare a small set of nations at different levels of corruption and gender inequality, with special reference to the impact on logistics.

Another opportunity is to connect constructs from the current study to other data, e.g. elements of the “doing business” index. Doing Business focuses on business regulations within nations. It covers a wide variety of topics, from starting a business to getting electricity to paying taxes. The Doing Business “Enforcing Contracts” topic includes an index on the “quality of judicial process,” which might be related to the CPI. Further, its “Trading across Borders” topic consists of indicators covering the time and cost to process imports and exports. Since Doing Business does not explicitly include logistics, it would be useful to assess relationship between LPI and these trading across borders indicators (World Bank Group 2019).

Additional research is also needed on practical implementation issues. Perhaps the most critical research question is: If corruption and gender inequality are detrimental to logistics performance, then what should businesses, governments and NGOs working in countries with poor performance do? How can nations be steered in a new direction, toward gender equality? How can Sudan (GII = .564; LPI = 2.428) become more like Sweden (GII = .044; LPI = 4.053), at least in terms of gender equality and logistics? There are no easy answers to these questions, as the scourge of gender inequality extends far beyond the scope of logistics. While there is much more than logistics at stake, logistics educators and practitioners can make a difference as advocates for gender equality and transparency.

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Figure 1. Paths in the Hypothesized Model

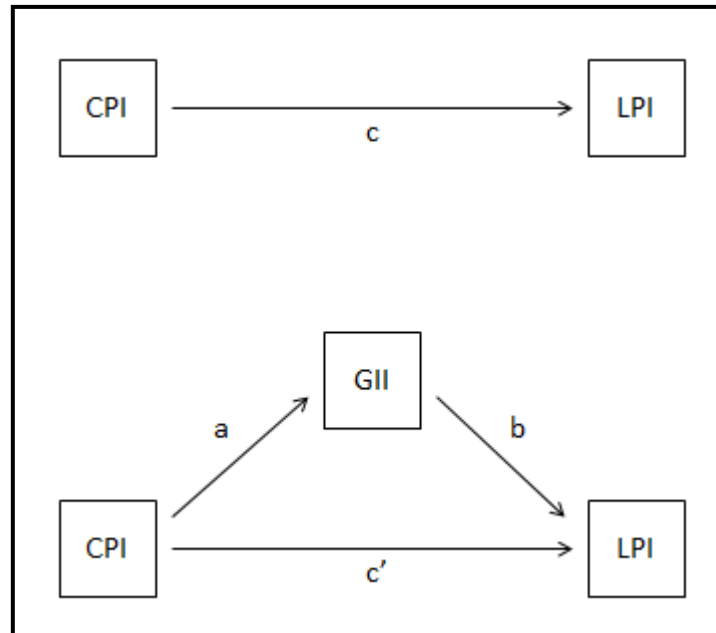


Table 1. Summary of Regression Results, with GII as mediator

Path	Test	R-square	F-stat.	Beta	Std. error	t-statistic	95% CI**
c (CPI → LPI)	H1	.6406	249.58*	.0236	.0015	15.798*	.021, .027
a (CPI → GII)	H2	.5581	176.80*	-.0076	.0006	-13.297*	-.009, -.007
b (GII CPI → LPI)	H3	.7029	164.44*	-1.0896	.2019	-5.398*	-1.489, -.609
c' (CPI GII → LPI)	H4			.0153	.0021	7.477*	.011, .019

\*p-value < .001

\*\*CI = confidence interval

Table 2. Regression Results, with GDP/capita as control variable

Model*	Test	Std. Beta	t-statistic	P-value	VIF
Constant			17.147	.000	
CPI	H1	.351	3.779	.000	4.055
GII	H3	-.348	-4.849	.000	2.415
GDP/capita	H5	.219	2.524	.007	3.552

\*Dependent variable = LPI

R-Square = .713; Adjusted R-Square = .706

F = 111.727 (p-value = .000)